

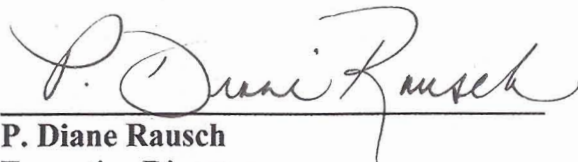
**National Aeronautics and Space Administration
Washington, DC**

NASA ADVISORY COUNCIL

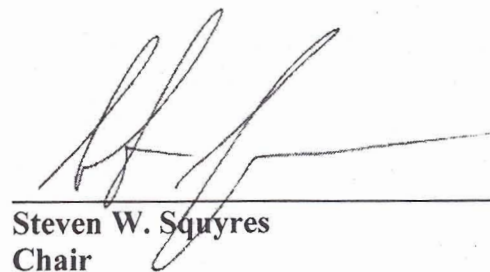
November 28-30, 2012

**Marshall Space Flight Center
Huntsville, Alabama**

MEETING MINUTES



**P. Diane Rausch
Executive Director**



**Steven W. Squyres
Chair**

**NASA ADVISORY COUNCIL
Marshall Space Flight Center
Huntsville, AL
November 28-30, 2012**

**Public Meeting Minutes
Table of Contents**

Call to Order, Announcements.....	2
Opening Remarks by Council Chair.....	2
Welcome to NASA Marshall Space Flight Center.....	2
Remarks by NASA Administrator.....	3
NASA Plans for Future Human Spaceflight.....	4
Human Exploration and Operations Committee Report.....	6
Council Discussion.....	6
Aeronautics Committee Report.....	7
Audit, Finance, and Analysis Committee Report.....	9
Science Committee Report.....	10
MSFC Early Career Scientist Presentation.....	11
Commercial Space Committee Report	11
Education and Public Outreach Committee Report.....	12
Information Technology Infrastructure Committee Report.....	13
Technology and Innovation Committee Report.....	15
Council Roundtable Discussion.....	16

Appendix A	Agenda
Appendix B	Council Membership
Appendix C	Meeting Attendees
Appendix D	List of Presentation Material

*Meeting Report prepared by
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NASA ADVISORY COUNCIL MEETING

NASA Marshall Space Flight Center
Huntsville, Alabama

PUBLIC MEETING

November 28-30, 2012

Wednesday, November 28, 2012

Call to Order, Announcements

Ms. Diane Rausch, Director, NASA Advisory Committee Management Division, Headquarters (HQ), and Executive Director, NASA Advisory Council (NAC or Council), called the meeting to order and welcomed the NAC members and attendees to the Marshall Space Flight Center (MSFC or Marshall) in Huntsville, Alabama. She stated that the NAC is a Federal advisory committee established under the Federal Advisory Committee Act (FACA). The meeting is open to the public. A dial-in capability is available for members of the public to listen to the meeting. WebEx is also available. Meeting minutes will be taken by Mr. David Frankel and will be posted to the NAC website, www.nasa.gov/offices/nac, soon after the meeting. Each NAC member has been appointed by the NASA Administrator, Mr. Charles F. Bolden, Jr., based on the member's individual subject matter expertise. Each member is a Special Government Employee, subject to ethics regulations, and must recuse himself or herself from discussions on any topic in which there could be a potential conflict of interest. Time has been set aside at the end of the day for public comments.

Opening Remarks by Council Chair

Ms. Rausch introduced Dr. Steven W. Squyres, Council Chair, who presided over the meeting. He welcomed everyone to the Council's public meeting and noted that it is a pleasure to hold the meeting at Marshall Space Flight Center. He thanked the Center Director, Mr. Patrick Scheuermann, for hosting the meeting. He reported that the Council members had an extraordinary tour of the facilities at Marshall and were inspired by the space and ground-based hardware that was shown to them on the tour. The planned agenda for the meeting was reviewed. Dr. Squyres reported that two Council committees, the Aeronautics Committee and the Science Committee, were working together on crosscutting issues relating to using Unmanned Aerial Vehicles (UAVs) as science platforms. Another crosscutting issue that he encouraged all committees to consider is the potential for third parties to use underutilized NASA facilities that are considered national assets.

Welcome to NASA Marshall Space Flight Center

Dr. Squyres introduced Mr. Patrick Scheuermann, who addressed the Council members and welcomed them to Marshall Space Flight Center. He noted that Marshall is known for development, testing, and manufacturing rockets, and for state of the art information technology. Dr. Larry Smarr was acknowledged for providing helpful insights on the subject earlier that morning. Marshall's priority is helping the Agency deliver the Space Launch System (SLS), the James Webb Space Telescope (JWST), and support the International Space Station (ISS). Marshall has an information technology and engineering employee pool that rivals the best in the nation. Young employees bring passion and energy to help solve today's problems and to prepare for the future. Marshall has been helping SpaceX and Orbital Sciences, as well as other more recent startup commercial companies. It also has a great relationship with its host on the U.S. Army's Redstone Arsenal military base. Marshall has many outreach and educational activities and is interested in inspiring the next generation.

Dr. Squyres thanked Mr. Scheuermann for his comments and for hosting the meeting. He added that he is looking forward to meeting an early career scientist from Marshall who will be briefing the Council later in the meeting.

Remarks by NASA Administrator

Dr. Squyres introduced Mr. Charles Bolden, NASA Administrator, as the next speaker. Mr. Bolden thanked Mr. Scheuermann for hosting the NAC meeting as the new Director of Marshall. Mr. Bolden noted that Mr. Scheuermann previously served as Director of the NASA Stennis Space Center, and as Chief Operating Officer at the Michoud Assembly Facility in New Orleans. NASA is fortunate to have a true rocket scientist at the helm at Marshall, especially as Marshall takes the lead in developing the new SLS, the next generation rocket system that will allow humans to travel further into space than ever before. Mr. Bolden thanked the NAC members for their willingness to serve on the Council and Dr. Squyres for his leadership on the NAC. He depends on them for charting NASA's future direction. The NAC formal recommendations to NASA are taken very seriously. A NASA formal response has been provided for the 17 recommendations that the NAC submitted to NASA during calendar year 2012. There may not always be agreement, but NASA listens very intently to the Council and values its input tremendously.

Several changes in NASA leadership were described. Dr. Richard Gilbrecht is now Director at Stennis. Mr. Robert Lightfoot is now the permanent Associate Administrator at NASA Headquarters. He is the top civil servant in the Agency. Mr. James Free will succeed Mr. Ray Lugo as Director of the NASA Glenn Research Center, and Ms. Ellen Ochoa will become the new Director at the NASA Johnson Space Center. These are outstanding leaders, and America is fortunate they have agreed to assume these important jobs at this pivotal time for NASA and space exploration.

Mr. Bolden explained that pursuant to an agreement among the bi-partisan leadership of the House and Senate and the President, the 2010 NASA Authorization Act adopted three priorities: SLS and the Multipurpose Crew Vehicle (MPCV) for human exploration; expansion and enhancement of the ISS for utilization to at least 2020; and the JWST as the premier science undertaking of our time. While NASA works with U.S. industry partners to develop commercial spaceflight capabilities, the Agency is also developing the Orion spacecraft to provide an entirely new capability for human exploration beyond low Earth orbit (LEO). Orion's first flight, Exploration Flight Test-1 (EFT-1), is scheduled for the fall of 2014 as an unmanned test that will have sufficient altitude and speed to simulate a Lunar or asteroid mission reentry and splash down. Orion will be paired with its initial 70-ton SLS heavy lift launch vehicle for an unmanned circumlunar mission in 2017. The first manned mission is targeted for 2020-2021. The ISS continues to be our gateway to the universe. For nearly 12 years, there has been at least one American astronaut living and working in space aboard the ISS. During the past decade, 15 nations have come together to design, assemble, occupy, and conduct research inside and outside the largest and longest-inhabited man-made object to ever orbit the Earth. Through advancing scientific knowledge and providing a space platform that inspires and educates tomorrow's science and technology leaders, the benefits to humanity from the ISS will drive its legacy as the research it produces strengthens economies and enhances the quality of life here on Earth for all people. NASA is committed to making this national resource available to the broader scientific and commercial research communities. The Center for the Advancement of Science in Space (CASIS), a nonprofit organization, has been selected to manage the National Laboratory on the ISS. Mr. Bolden identified the crew members recently returned from and those currently living aboard the ISS.

The JWST is scheduled for launch in 2018 on an European Ariane launch vehicle; it will be the most powerful space telescope ever built and will allow us to study every phase in the history of the universe. Innovative science missions are yielding data from orbits around the Sun, Mercury, the Moon, Mars, and Saturn. Missions are on the way to Jupiter, Pluto, and the dwarf planet Ceres. Sixteen missions in orbit study Earth as an integrated system. One mission, Aquarius, is mapping the salinity of Earth's oceans and monitoring the effects of ocean salinity on our environment. SERVIR, meaning "to serve" in Spanish, is providing Earth science data to help developing nations in Central America, East Africa, and the Himalayas. The Curiosity rover continues to provide new weather and radiation data about the Mars environment. The Kepler mission continues to identify planet candidates. Space weather has captured the imagination of people everywhere.

Mr. Bolden explained that undergirding all NASA's efforts in exploration is reliance and investment in technology. The Space Technology Program (STP) is supposed to take risks and develop game-changing technologies. The investment in technology not only advances space science and human exploration, it also advances the Nation's economy and future, and NASA's future as an agency. NASA wants to foster and encourage innovation, solve problems, and expand partnerships with innovators from academia, business, and individuals to create new products, companies, and economic opportunities. As NASA's Chief Technology Officer (CTO), Dr. Mason Peck, asserts: "You can put your ideas in space." Essential to the success and survival of the ISS is a viable commercial cargo and crew program to provide access to the ISS and other LEO destinations on American vehicles launched from American launch sites. The SpaceX Dragon spacecraft recently splashed down in the Pacific, successfully ending the first commercially contracted cargo delivery flight to the ISS. This is very important because the mission was completed with a system built by a private firm - an American company - that is creating jobs and helping keep the U.S. the world leader in space. Orbital Sciences Corporation is planning to launch its Antares launch vehicle and Cygnus spacecraft for a demonstration flight to the ISS early next year.

In response to a question from Dr. Squyres about the potential for interaction between the Science Mission Directorate (SMD) and the Human Exploration and Operations Mission Directorate (HEOMD), Mr. Bolden explained that NASA is striving to see that happen, while assuring the science community that funding will not be taken from one to supplement the other. The ultimate destination for humans is Mars, and one question for everything NASA does in Science is whether there is some implication for that goal. Aeronautics also plays a big role in what is done at NASA. Ms. Marion Blakey provided Mr. Bolden with a report commissioned by the Aerospace Industries Association (AIA) on the contribution and financial impact the U.S. aerospace and defense industry has had on the American economy.

Dr. Squyres thanked Mr. Bolden for his time and for his comments.

NASA Plans for Future Human Spaceflight

Dr. Squyres introduced Mr. Bill Gerstenmaier, Associate Administrator, Human Exploration and Operations Mission Directorate (HEOMD), NASA Headquarters. Mr. Gerstenmaier explained that the ISS is a scientific laboratory, a technology testbed, an orbiting outpost, a galactic observatory, and an economic innovative engine, bringing direct benefits to the people on Earth. Several benefits were discussed. Ultrasound was developed to substitute for an x-ray machine, which is not available on the ISS. This concept was adopted by the Detroit Red Wings hockey team and now is being used at children's soccer games. A discovery in ophthalmology indicates that prolonged exposure to microgravity adversely affects vision and intracranial pressure. In response to a question from Mr. Richard Kohrs, Mr. Gerstenmaier explained that this problem could impose limits on the human ability to travel long distances in space. Candidate vaccines or treatments for salmonella, methicillin-resistant staphylococcus aureus (MRSA), prostate cancer, and Duchenne's muscular dystrophy have been developed through research on the ISS. A chart was presented showing an increase over time in the number of research and technology investigations in the ISS. He stated that the ISS is now completed; the assembly effort is over. It is now time to use this unique space platform.

Mr. Gerstenmaier described recent highlights in space life and physical sciences. The ISS Advanced Resistive Exercise Device has been shown to be an effective countermeasure against bone and muscle loss in space. Important advances have been made in radiation risk assessment, high fidelity biomedical imaging, and combustion research. Experiments on magnetorheological fluids demonstrated how pulsating magnetic fields can be used to create unique materials and electromechanical devices. The new Center for the Advancement of Science in Space (CASIS) has announced selections from its initial research solicitation in protein crystal growth, an area that has strong economic potential. The CASIS Board of Directors has just been selected, and he will meet with them on December 13, 2012. Rodents will probably be used in investigations on the ISS because they have an immune system similar to humans. Dr. Smarr recommended paying more attention to microbes due to recent advances in genetic sequencing and because the immune system is dependent on microbes, which constitute 90 percent of the cells in the human body.

Mr. Gerstenmaier noted that progress on the SpaceX Falcon 9 rocket and Dragon capsule is going well. A Certification Products Contract (CPC) solicitation has been issued for multiple awards to purchase early life cycle certification data products related to an end-to-end Crew Transportation System (CTS). This will enable industry to

tell NASA the specifications that need to be changed for industry certification and verification plans. The SLS and MPCV programs are working toward sending humans to explore deep space. The Orion MPCV is scheduled for an initial test flight on a Delta IV rocket in 2014. Demonstration tests that have been completed were described. A crack observed during an Orion capsule pressure test was discussed. The uncrewed EFT-1 in 2014 and uncrewed Exploration Mission 1 (EM-1) in 2017 will validate that the systems are safe for human travel. The crewed Exploration Mission 2 (EM-2) in 2021 will replicate EM-1 to validate human risk mitigation techniques developed for the integrated SLS-MPCV system. Dr. William Ballhaus suggested that measurements from the heat shield used for Mars Science Laboratory (MSL) could enable weight to be eliminated from future heat shields.

Advanced Exploration Systems (AES) accomplishments in FY 2012 were described. A prototype Portable Life Support System for the advanced spacesuit has been assembled. The Morpheus lander completed 20 tethered flight tests. The Goldstone radar has imaged 12 near-Earth asteroids. A new lunar rover, the Regolith and Environment Science and Oxygen and Lunar Volatile Extraction (RESOLVE), designed in partnership with the Canadian Space Agency to prospect for water and other volatiles on the lunar surface, was field tested in Hawaii. The Lunar Laser Space Terminal was described. The Launch Services Program FY 2013 Plan was discussed. Charts were presented showing Exploration mission needs, incremental steps for a deep space capability, and mission needs for humans at Mars. Mr. Gerstenmaier explained that HEOMD is demonstrating capabilities and reducing risk toward eventual human Mars exploration. The primary risks to mitigate are life support, spacecraft reliability, radiation protection, psychological degradation prevention, and transportation system performance. In response to an inquiry from Dr. Squyres, Mr. Gerstenmaier confirmed that the European Space Agency (ESA) will build the service modules for EM-1 and EM-2, putting ESA on the critical path. The interfaces are designed to be severable and the U.S., through Lockheed, will retain responsibility for high-risk integration activities. Having international partnerships will lead to a more robust spacecraft, although it will not save costs, due to higher integration expenses. This work will be accomplished under ISS agreements to avoid International Traffic in Arms Regulations (ITAR) issues. In response to a question from Mr. Kohrs, Mr. Gerstenmaier reported that ESA has agreed to adopt NASA's lighter-weight stringer configuration.

Mr. Gerstenmaier described how the ISS is being used to enable deep space missions. One concern discussed was crew autonomy and time-delay communications. A one-year increment by a U.S. astronaut and a Russian cosmonaut is planned for 2015. Dr. Squyres described the difficulties relating to time-delay communications that he experienced while participating on a NASA Extreme Environment Mission Operation (NEEMO) 16. The ISS is being used as a technology testbed for new systems and technologies critical for long-duration deep space missions. It is also a proving ground for Commercial Cargo and eventually Commercial Crew and other commercial activities. The international partners for the ISS want to explore with the U.S. and have useful hardware to contribute. NASA is exploring leveraging those partnerships to go beyond LEO. Mr. Gerstenmaier explained that operational experience must be gained for activities beyond LEO. The NASA Science Mission Directorate (SMD) has experience in that, and HEOMD needs to learn from it.

Dr. Ballhaus advised that it is important to become comfortable with taking higher risks. Mr. Gerstenmaier concurred. Mr. Bolden discussed risk tolerance. He explained that risks in operations cannot be minimized unless more risks are taken in the developmental phase. If a test pilot is not occasionally scared, he explained, then the envelope is not being pushed far enough. Dr. Smarr recommended using robots on more missions to reduce the risk of losing humans. Mr. Gerstenmaier indicated that there would be more human/robotic missions, and that more spacewalks would be robotic. He cautioned, however, that humans should be brought into the environment at the right time, and that it is the combination that will accomplish exploration at the fastest pace. He concluded by observing that HEOMD is making tremendous progress in a very fiscally constrained environment, and that the budget is a primary concern. Science, technology, and human systems all need to be part of exploration for NASA, and every new system being designed has to have a purpose for the future. In response to a question from Dr. Squyres, Mr. Gerstenmaier stated that developing a better cryogenic storage system for propellants is very important. In response to a question from Ms. Blakey, Mr. Gerstenmaier explained that it will be important to reach an understanding with the International Partners on when to retire the ISS. Solar panel degradation and other structural issues on the ISS will be significant problems by 2028. A commercial space station may be available by that date. Mr. Robert Hanisee advised that retaining the ISS for a longer period would help maintain a high-level astronaut

training program. Mr. Gerstenmaier concurred. Dr. Smarr counseled that a test flight every two years is an incredibly low launch rate that could be problematic.

Dr. Squyres thanked Mr. Gerstenmaier for his presentation.

Human Exploration and Operations Committee Report

Dr. Squyres introduced Mr. Richard Kohrs, Chair, Human Exploration and Operations (HEO) Committee. Mr. Kohrs described the Committee's membership and then reviewed the briefings that the Committee received at its last meeting. He briefly reviewed subjects and charts covered by Mr. Gerstenmaier in his presentation to the Council. Mr. Kohrs described the ISS status. The internal rack capacity will soon be at 80 percent, and items will need to be returned to Earth. The transition to CASIS was discussed. Graphs were presented on research aboard the ISS. In response to a question from Ms. Blakey, Mr. Kohrs explained that the Japanese Space Agency (JAXA) conducts more experiments than ESA because there is an external payload capability on their module. In addition, all the ISS freezers are on the Japanese module. Ms. Blakey observed that as storage space becomes less available, it will become important to understand how that space is allocated. Mr. Kohrs noted that the ISS is offering free transportation, power, and crew time to experimenters, and he commended the Agency for its effort to get experiments onto the ISS. A chart was presented showing how HEOMD's education and communications goals are aligned with the Agency's goals. The certification process for the Commercial Crew Program (CCP) was described. Charts showing the CCP Roadmap and NASA Certification Strategy were presented. The partners selected for Commercial Crew Development Round 2 (CCDev2) were Blue Origin, Boeing, Sierra Nevada, and SpaceX. Space Act Agreements (SAAs) for Commercial Crew Integrated Capability (CCiCAP) were entered into with Boeing, Sierra Nevada, and SpaceX. The Federal Acquisition Regulation (FAR) solicitation process will be used to establish certification requirements because NASA does not use a SAA to impose specific requirements on a contractor. In response to a question from Mr. Hanisee, Mr. Kohrs explained that SpaceX will use its own launch vehicle, and the other contractors will use the Delta IV rocket. Mr. Kohrs noted that HEOC had met with the Science Committee for a joint briefing on the Mars Program Planning Group (MPPG) Report.

Mr. Kohrs presented a proposed recommendation for the HEO Committee and the Science Committee to be provided with a status update on the disposition of the MPPG Report. Ms. Blakey expressed an interest in having the full Council be briefed on the matter. The Council agreed to table the recommendation and Dr. Squyres indicated that the Agency's response to the Report would be added to the NAC's next agenda.

Mr. Kohrs presented a proposed recommendation that NASA solicitations require proposals to include outreach plans that would be evaluated. He noted that the recommendation has been reviewed by NASA's legal department. After discussion, it was agreed to table the recommendation while Committee Chairs Robert Hanisee, Richard Kohrs, Lars Perkins, and Patty Smith work together to revise the language.

Mr. Kohrs discussed NASA's response declining a previous Council recommendation advising that NASA obtain a systems integration contractor to provide specialized integration services for the SLS. The HEO Committee subsequently requested NASA to provide a detailed schedule showing how systems integration will be accomplished, and the Committee will review the schedule. Dr. Squyres noted that the recommendation was important, and that he was disappointed with NASA's response. He commended the Committee for the thoughtful way it is addressing the issue, and the Council concurred.

Dr. Squyres thanked Mr. Kohrs for his presentation.

Public Input

Dr. Squyres invited comments from the public. There were none.

Council Discussion

Dr. Squyres observed that the role to be played by ESA in developing Orion is unusual for a major U.S. human spaceflight system. Mr. Kohrs advised that it is a good idea because international participation is necessary and

cannot be accomplished without putting the participants into the critical path. Dr. Squyres counseled that this is a new and significant development. He advised that the Council should delve more deeply into ESA's involvement. Dr. Smarr opined that NASA is designing a complicated technology that is looking for a mission, and he expressed disappointment because there had not been a presentation analyzing the need for a destination. Dr. Squyres agreed to continue to press for one. Mr. Kohrs discussed the plan to use the ISS as a platform for testing the ability to travel great distances where autonomy is needed and advised that it would be better to do the testing on the ground.

Adjournment

The meeting was adjourned for the day at 5:00 p.m.

Thursday, November 29, 2012

Call to Order, Announcements

Ms. Rausch called the meeting to order and welcomed everyone to the second day of the meeting. She reminded everyone that the NAC is a Federal advisory committee established under the FACA. The meeting is open to the public. A dial-in capability is available for members of the public to listen to the meeting. WebEx is also available. Meeting minutes will be posted to the NAC website soon after the meeting. All presentations and comments will be part of the public record. Time has been set aside at the end of the day for public input.

Remarks by Council Chair

Ms. Rausch introduced Dr. Squyres, NAC Chair. He reviewed the agenda for the day. He noted that one of the highlights of the day will be a presentation from an early career scientist from Marshall Space Flight Center, Dr. Jonathan Curtain.

Aeronautics Committee Report

Dr. Squyres introduced Ms. Marion Blakey, Chair, Aeronautics Committee. She noted that four new members have been added to the Committee. The Committee's last meeting was at the NASA Glenn Research Center (GRC) in Cleveland. The topics covered by the Aeronautics Committee at that meeting were the GRC Aeronautics Workforce, Aeronautics Test Facilities, the Environmentally Responsible Aviation (ERA) project status, Aviation Safety Technology Transfer, a briefing by the Unmanned Aircraft Systems (UAS) Subcommittee, and interactions between the Aeronautics Research Mission Directorate (ARMD) and the National Research Council (NRC). Charts were presented on GRC's core competencies and its workforce retirement eligibility. Ms. Blakey noted that the workforce at GRC is older than NASA's average workforce.

Ms. Blakey discussed wind tunnel capacity. In 1993, NASA and the Department of Defense (DoD) owned 60 wind tunnels. That number has been reduced to 27 in 2012. The Aeronautics Test Program (ATP) and its business practices were discussed. The ATP was created in 2006 to manage capabilities that were identified by the Rand Corporation as "strategically important" to the nation.

Ms. Blakey submitted a proposed finding to endorse the management strategy engaged in by ARMD for the aeronautics test facilities. Dr. Ballhaus noted that wind tunnel testing by industry at NASA facilities was free until NASA changed to full cost accounting, and that NASA's wind tunnel capabilities declined after the change. He opined that it will be difficult to maintain world-class facilities due to the shift to full cost accounting, and he recommended that the Committee explore whether it should be NASA's job to continue to operate wind tunnels. Dr. Squyres agreed that the Committee should look into this issue. After further discussion, the Council adopted the following finding:

The Council endorses the management strategy engaged in by ARMD for the aeronautics test facilities. The corporate management of the facilities by the Aeronautics Test Program (ATP) has resulted in a strategic, long-term commitment by NASA to retain and invest in test capabilities that are considered important to the Agency and the

Nation. The balanced business approach utilizing outside aeronautics test facility needs taken by the ATP within ARMD has resulted in economies of scale and the ability to fund the development and employment of highly specialized technical resources that provide NASA and the U.S. aerospace community a vital infrastructure within critical budget constraints. The approach ARMD ATP took to addressing the challenge of maintaining and enhancing critical infrastructure is a best in class approach that should be studied by any organization attempting to improve benefits to their customer community.

The Environmentally Responsible Aviation Project was described by Ms. Blakey. It has three goals: reduce nitrogen oxide emissions, reduce noise, and reduce aircraft fuel consumption. A chart was presented showing the Technology Focus Areas (TFAs) for each goal. Ms. Blakey discussed aviation safety technology transfers and the challenge to aviation safety research and development (R&D) posed by the need for verification and validation. Complex flight-critical systems pose significant challenges to safety assurance, and NextGen plans will escalate the problem. The NASA Aviation Safety Program (ASP) and the Federal Aviation Administration (FAA) Office of Aviation Safety (ABS) are collaborating in conducting research to promote safety assurance of software, digitally-intensive systems, and operational concepts.

Ms. Blakey reported on a briefing by the UAS Subcommittee. Autonomy has the potential to increase performance, productivity, safety and efficiency, reduce costs, and enable new operational models. NASA has been working closely with the FAA's UAS Aviation Rule Making Committee (ARC). Ms. Blakey submitted a proposed recommendation that ARMD provide leadership in research on intelligent and autonomous aviation technologies. In response to a question from Dr. Charles Kennel, Ms. Blakey explained that DoD has been a good partner and is interested in opening the national space for their own testing; in addition, the Department of Homeland Security (DHS) is interested in UAS for surveillance purposes. Dr. Squyres noted that the recommendation was advancing an important new priority for aeronautics research and asked whether it was higher than other current priorities. Ms. Blakey responded that the Office of Management and Budget (OMB) is very interested in UAV and, therefore, this is not a zero-sum item. The Council approved the following recommendation:

The Council recommends that NASA ARMD provide strategic Agency and national leadership, in coordination with the private sector and other government agencies, for current and future research activities in intelligent and autonomous aviation technologies. Areas of research would include safe, effective allocation of functions between humans and automation and target development of core technologies in machine intelligence and autonomous systems that address crosscutting technical challenges. The testing and certification of these non-deterministic software systems that are focused on enabling autonomous operations in complex, uncertain environments is a special area of concern and interest. NASA's efforts should generate the knowledge and concepts necessary to inform operations, safety and certification standards and procedures for non-deterministic systems.

Dr. Squyres requested that the recommendation be rephrased more concisely.

Ms. Blakey discussed a NRC study on Flight Research. She noted that NASA's goal is to define a healthy flight research level, determine how best to integrate flight research into the ARMD portfolio, and determine the resources needed to sustain the flight research capability. A chart showing how flight research spans all technology readiness levels (TRLs) was presented. Ms. Blakey explained that a stable investment in research is critical. She presented a proposed recommendation that NASA expand the use of flight tests as an integral part of its overall research portfolio and that the expanded flight research be dedicated to the legacy of Astronaut Neil Armstrong. The recommendation was presented as follows:

Over the past few years, a number of external and internal assessments of NASA's Aeronautics research programs have been undertaken. More recently, at the request of NASA, the National Research Council (NRC) undertook a study of how best to integrate flight research in ARMD's current research activities. The NASA Advisory Council strongly endorses the critical role of flight research as underscored by the NRC and believes that NASA should sustain and enhance that capability. The NASA Advisory Council believes that there is significant value in proving technology performance in a relevant environment via flight testing.

The NASA Advisory Council feels that the current balance between fundamental and integrated systems-level research within the ARMD is appropriate for the given funding level. The Council also agrees with ARMD's plans for where and how to employ flight testing within the given budget, and expects this work to continue to advance aviation and aerospace. However, the Council believes there is an opportunity for NASA to make even more substantial contributions by supporting more robust flight research, which will result in a much better balance among all critical elements of conducting world class research: analytical methods, ground testing, and flight testing.

The NASA Advisory Council therefore recommends that NASA expand the use of flight test as an integral part of its overall research portfolio. However, the Council believes that additional resources outside of those currently allocated will be necessary to effectively implement additional flight research activities and it would be advantageous for ARMD to collaborate as much as practical with industry and other government agencies.

In recognition of Neil Armstrong's dedication and contributions to both the NRC study and flight research, including as an X-15 test pilot, the NASA Advisory Council believes that expanding the depth of flight research at NASA could be appropriately dedicated to his legacy.

Mr. Perkins advised that this is a great message from a public outreach perspective because it links spaceflight to aeronautics. Dr. Squyres concurred, and noted that the late Mr. Armstrong had been the public face of NASA for decades, and always considered himself as a pilot first. Dr. Squyres requested that the recommendation be rephrased more concisely.

Dr. Squyres thanked Ms. Blakey for an excellent report.

Audit, Finance, and Analysis Committee Report

Dr. Squyres introduced Mr. Robert Hanisee, Chair, Audit, Finance, and Analysis Committee. Mr. Hanisee noted that NASA had received an unqualified clean audit opinion for FY 2012. There remains a significant deficiency with respect to NASA's environmental liability estimation process. A corrective action plan for estimating asbestos remediation is being developed, and the deficiency should be eliminated. Charts on the Office of Chief Financial Officer (OCFO) FY 2013 Key Initiatives and Integrated Product Team Planning were discussed. Mr. Hanisee presented a chart showing how NASA achieved actual administrative savings of \$166.8 million, which exceeded mandated target savings of \$100 million. He explained how the savings were re-invested to serve critical Agency programmatic and institutional needs. A chart was presented showing how an additional \$100 million in directed administrative cost savings are to be achieved in FY 2013. Mr. Hanisee noted that deferred maintenance is over \$1 billion. The budget cycles through FY 2015 were described.

Mr. Hanisee explained that the budget outlook for FY 2013 is still unclear because the Administration and Congress are negotiating the FY 2013 budget. Some direction can be taken from House and Senate bills that largely reflect FY 2012 enacted appropriations. In the near-term, NASA faces the "fiscal cliff" and potential debt limit breach. The immediate effect on NASA could be sequestration; however, a Continuing Resolution (CR) plan underway takes into account some of that risk. In the long term, NASA's spending will likely be constrained. A chart showing the overall effect on NASA from a possible sequester was presented. Mr. Hanisee noted that the amount to be sequestered is based on an annual percentage that would have to be implemented in just nine months. Moreover, there are some operational programs, for example the ISS, that cannot be cut.

NASA's presence since 1990 on the GAO High Risk List was discussed. The GAO designated NASA's acquisition management as high risk due to persistent cost growth and schedule slippage in most major projects. Mr. Hanisee described the criteria for being included on GAO's High Risk List. He noted that NASA has expended considerable resources to address the problem, but with scant progress. The Committee believes that it may be difficult for NASA to ever get off the list because the GAO does not understand NASA. Mr. Kohrs advised that budget reductions are a primary source for cost growth. Dr. Ballhaus observed that NASA does not have a "gold standard" for cost estimating, which he explained means an estimating team with the best possible estimators. Dr. Squyres counseled that being on the high risk list may not be inappropriate given NASA's mandate to be bold and take risks. In response to a question from Ms. Smith, Mr. Hanisee explained that there are no consequences to being on the list, although

Mr. Bolden has stated that getting off the list is important. Mr. Hanisee added that there is no possibility for NASA to get off the list as long as there is the JWST. He noted that NASA is a risk-taking organization and quipped that it should be a badge of honor for NASA to be on the list. Ms. Blakey reported that the FAA had been on the list and worked hard to be removed from it.

Dr. Squyres thanked Mr. Hanisee for his presentation.

Science Committee Report

Dr. Squyres introduced Dr. Wesley Huntress, Chair, Science Committee. Recent science results were described. The Curiosity rover landed safely on Mars. It weighs approximately one ton and carries a host of advanced instruments for geochemistry. Its goal is to determine whether there was a possibility for life on Mars in the past. The Mars Science Laboratory used a unique landing system involving a "skycrane." The video "Seven Minutes of Terror," which focused on the descent and landing, was presented. It can be viewed at the following location on YouTube: http://www.youtube.com/watch?v=SV6w_ju9kMo. Dr. Squyres observed that NASA belongs on the GAO High Risk List for attempting this mission. Dr. Huntress noted that 200,000 people stayed up to watch the landing in the middle of the night in Times Square, New York City, even though this was only a robotic mission. Slides of Curiosity landing on Mars were shown. Curiosity began its trek near an area that has an conglomerate material with rounded pebbles, indicating an ancient river bed. The next mission to Mars will be the Mars Atmosphere and Volatile Evolution Mission (MAVEN), which will explore the upper atmosphere. That will be followed in 2016 by the Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission, which will look at seismic activity. The Science Committee and HEO Committee received a joint briefing on the MPPG Report. Dr. Huntress opined that the Report shows the way forward. The Radiation Belt Storm Probes (RBSP) mission, was launched successfully in August 2012. Dr. Huntress described radio waves in space that are audible to the human ear, and played an audio clip. Slides showing a planet being consumed by its star and carbon dioxide emissions over California were shown.

Dr. Huntress discussed the SMD's programmatic status. There will be five launches in the next 23 months. Work on new Venture class low-cost missions is underway. A study is being performed on how to use the two telescopes given to NASA by the National Reconnaissance Office (NRO). The JWST is on schedule and budget. Its mirrors have been completed and sunshield deployment testing has begun. It is scheduled for launch on an Ariane in 2019. Instruments onboard the ISS for investigating cosmic rays were described. The NRC Space Studies Board released a decadal report entitled "Solar and Space Physics: A Science for a Technological Society," authored by the NRC Committee on a Decadal Strategy for Solar and Space Physics (Heliophysics). A program to produce new Plutonium 238 (Pu238) needed to power spacecraft in the outer solar system has been restarted. Planetary science suffered drastic budget reductions in FY 2013, and will have no funds for a flagship mission. Outer planet missions are being re-examined. Announcements of Opportunity (AOs) will be delayed, and some currently operating missions will have to be turned off. In response to a question from Dr. Ballhaus, Dr. Huntress opined that the reduction in funding would cause NASA's Jet Propulsion Laboratory (JPL) to lose hundreds of employees and outer planet core competencies. The Science Committee is concerned about SMD staff reductions. There has been a 35 percent reduction, compared to a three percent overall NASA staff reduction. Dr. Huntress counseled that management by heroic effort is not sustainable. Dr. Smarr has been briefing the Science Committee's Subcommittees on the need for a study on NASA's cyber-infrastructure by the NAC Information Technology Infrastructure Committee..

Dr. Huntress presented a proposed recommendation for a planetary protection procedural requirements document for human extraterrestrial missions. This had been presented at the last NAC meeting. A white paper on the subject was distributed to Council members prior to the current meeting. Dr. Squyres explained that two elements determine when the document is needed: it must be timely, and it must reflect the state of knowledge about Mars, which will always be evolving. Dr. Huntress advised that the requirements need to be established once the destination is known, and he observed that the Agency is intent on going to Mars. Dr. Squyres explained the distinction between "forward contamination," where contamination occurs by terrestrial material carried to Mars, and "back contamination," where the Earth is contaminated by material returned from Mars. Dr. Huntress counseled that the public is most concerned with back contamination. Dr. Squyres suggested adding to the recommendation a requirement for the document to be updated as new knowledge becomes available. The Council approved the recommendation as follows:

The NASA Advisory Council recommends that NASA develop the appropriate implementing document to specify planetary protection procedural requirements for human extraterrestrial missions at a level corresponding to the current COSPAR (Committee on Space Research) planetary protection policy, and update it as new knowledge becomes available.

Dr. Squyres thanked Dr. Huntress for his presentation.

MSFC Early Career Scientist Presentation

Dr. Squyres introduced Dr. Jonathan Cirtain, Senior Heliophysicist, Heliophysics and Planetary Science Office, MSFC. Dr. Cirtain discussed his recent small science initiative in solar sounding rocket instrumentation at MSFC under the Low Cost Access to Space (LCAS) suborbital program. He explained that the term “sounding” is from the nautical expression to measure depth. In NASA’s case, it means “to measure.” Sounding rockets have two flight profiles: altitude vs. time and altitude vs. distance. They are the best way to access the terrestrial atmosphere between 30 to 150 miles. The sounding rocket lifecycle follows the same lifecycle as large missions. He developed an instrument named the High Resolution Coronal Imager (Hi-C) to see what the Sun looks like at high spatial resolution. It required mirrors that were Hubble-quality in terms of smoothness. The mirrors took two years to fabricate and cost \$150,000 to develop. Hi-C was launched on July 11, 2012, and reached Mach 7 in 17 seconds. Dr. Cirtain described the experiment’s results. High resolution images allowed him to confirm a fundamental physics theory on how energy on the Sun’s surface is stored and released through solar flares. A solar flare predictive tool has now been developed as a result of the experiment. He noted that *Nature* magazine has accepted the Hi-C experiment results for publication and will feature it on the magazine’s cover in January 2013. In response to a question from Dr. Squyres, Dr. Cirtain explained that the experiment began with only an idea, and that Marshall had the infrastructure and expertise that allowed him to develop the idea into the Hi-C instrument. In response to a question from Dr. Kennel, Dr. Cirtain explained that researchers at a university would not have had access to the facility resources available at Marshall.

Dr. Squyres thanked Dr. Cirtain for his presentation.

Commercial Space Committee Report

Dr. Squyres introduced Ms. Patti Grace Smith, Chair, Commercial Space Committee. She described the Committee’s membership and discussed recent highlights in NASA’s commercial space programs. SpaceX completed the first commercial cargo resupply mission to the ISS. A video was presented showing the SpaceX Dragon capsule being launched by the SpaceX Falcon 9 rocket, its capture by the ISS space arm, and its return to Earth. The video can be found at <http://www.nasa.gov/exploration/commercial/crew/index.html>. A video was presented showing Sierra Nevada Corporation’s Dream Chaser space capsule in free flight after being dropped from a helicopter. The video can be found at <http://www.youtube.com/watch?v=V-zG5QvIBaw>.

Three contracts for the next phase of Commercial Crew, the Commercial Crew Integrated Capability (CCiCap), have been awarded to Sierra Nevada Corporation, SpaceX, and Boeing. The contracts have a 21-month base and are intended to culminate in a level of maturing approximately equivalent to a Critical Design Review (CDR). Charts were presented on the Committee’s Strategy and Accomplishments for 2012 and on its recent meetings. The Committee met twice with Ms. Courtney Graham from NASA’s Office of General Counsel for explanations on the Space Act Agreement process.

Ms. Smith presented the following proposed finding:

The Council finds that there is increasing acceptance of commercial approaches across NASA.

With the retirement of the Space Shuttle and termination of the Constellation program, current Agency policy includes “commercialization” of low Earth orbit transportation. Initially, this transition was not widely accepted by many current or former NASA employees. Some former astronauts and contractors were particularly vocal in Congressional testimony and other public venues in resisting the change away from NASA’s traditional method of developing, funding, and managing major programs. However, there is evidence that this is changing. Metrics for

the progress include the messaging NASA delivers in press releases, public statements and testimony, and validation from NASA's partners. The increasing acceptance appears to be due in part to the widening realization that the change is necessary.

Furthermore, after visiting four NASA Centers and talking with all ten Center Directors (or their deputies), the Council finds that commercialization initiatives are in place at every NASA Center. These initiatives appear in various stages, depending on local factors such as facilities, Center geographical location, Center Director interest and communication, outside interests, and funding constraints. Most Centers are actively pursuing new opportunities for commercial partnerships, and are interested in removing impediments to quick and efficient implementation. Employees appear to accept that commercialization of low Earth orbit transportation is just one piece of a broader NASA strategy that includes challenging current in-house work to enable beyond-Earth exploration.

In response to a question from Mr. Perkins, Ms. Smith confirmed that the acceptance is a huge improvement. Dr. Squyres noted "it is a cause for rejoicing." The Council approved the finding.

Ms. Smith presented a proposed recommendation for NASA to evolve its workforce to accommodate the Agency's future direction in overseeing commercial initiatives. The recommendation restated a previous recommendation that the Council had submitted to the Agency. NASA's response had agreed with the future direction but did not agree that there was a lack of depth in the skills needed. The Committee then conducted its own investigation. The Committee found that the necessary business acumen was inadequate and, therefore, it believes the Agency's response was not satisfactory. Ms. Rausch read to the Council the Agency's recent response to the original recommendation. Dr. Squyres concurred that the Agency's response did not seem to be satisfactory. Dr. Ballhaus counseled that NASA does not understand markets and does not groom people to understand business marketing. Mr. Hanisee expressed a concern that without a change in culture, the internal resistance in NASA to commercial crews would "nitpick the commercial companies by a thousand cuts." Mr. Kohrs observed that this is not confined to commercial crew and extends throughout the Agency. Ms. Smith opined that there would continue to be tension. Dr. Smarr expressed amazement at the cooperation he saw between the "old hands" at Marshall and the commercial space partners, considering the half-century cultural divide they are attempting to change. Upon Dr. Squyres' suggestion, Ms. Smith agreed to resubmit the recommendation later in the meeting with additional information in the background section on the need for new hires. Dr. Squyres thanked Ms. Smith for her presentation.

Education and Public Outreach Committee Report

Dr. Squyres introduced Mr. Lars Perkins, Chair, Education and Public Outreach (EPO) Committee. Mr. Perkins described the Committee's membership. He stated that his previously presented "taxi driver problem" still exists; the general public still believes that the end of the Space Shuttle program has resulted in the end of NASA as an agency. Mr. Kohrs reported about a recent incident where an insurance adjuster sitting next to him on a flight thought that NASA had been turned over to a commercial company. This demonstrated to him that professional personnel are also confused over NASA's identity.

Mr. Perkins presented several slides showing excitement over the MSL landing on Mars on August 5, 2012 (PDT). He showed a video entitled "We're NASA and We Know It," that had been made by young fans without any funding from NASA. The video has gone viral and received over 2 million views. Mr. Perkins explained that the video resonates with a demographic that has not resonated with NASA for a long time. The video can be found at http://www.youtube.com/watch?feature=player_embedded&v=QFvNhsWMU0c#!. Recent media attention on NASA was described. A slide was presented showing news coverage on JPL employee Bobak Ferdowsi, an MSL mission controller who achieved Internet stardom when he sported a Mohawk haircut during the broadcast of Curiosity's landing. Time magazine selected NASA's website, www.nasa.gov, as among the 50 best websites in 2012. Dr. Smarr complimented NASA for producing very clever and engaging Twitter feeds from the Curiosity lander. Slides were presented on media coverage from the last Space Shuttle's retirement.

Mr. Perkins noted that NASA's Office of Education is making significant changes to its portfolio in order to increase efficiencies. A slide was presented on the One Stop Shopping Initiative (OSSI) for NASA internships. He opined that

the MSL represents a new era in exploration and Science, Technology, Engineering, and Math (STEM) education opportunities. Mr. Will.i.am of the Black Eyed Peas music group released a song entitled "Reach for the Stars" during a recent event at JPL where local high school students learned about the excitement possible in STEM fields. In response to a question from Mr. Kohrs, Mr. Perkins explained that NASA TV is under-funded, under-produced, and under-resourced. Mr. Perkins advised that a commercial partner would make NASA TV more marketable and engaging.

The status of previous NAC recommendations initiated by the EPO Committee was reviewed. The Agency approved the recommendation to elevate the Communications Coordinating Committee to a Council. Action has not been taken on the recommendation to develop "centers of excellence" for education and public outreach activities. The Agency concurred with the recommendation to develop one overarching message for all NASA activities. The Committee will closely follow the details on how that is implemented. Mr. Perkins advised that there is a need to craft ambitious and inspiring goals for NASA's directorates. The goals need to be realistic, durable, and funded, and have to span multiple Administrations. A one sentence answer is needed to the question, "How does NASA fit into the national STEM initiative?" NASA's strategic assets that reflect capabilities that have been developed by the Nation should be funded. Mr. Perkins asserted that NASA is trying to inspire, not market, and should inspire around a common theme. At the Associate Administrator level, the strategic messages that need to be communicated should be integrated back to that organization's strategic goals. Some notion of NASA's unifying message should be included in every message that NASA communicates.

A slide was presented on an evolving prototype for a NASA website. The source of funding for EPO was discussed. It was noted that SMD Policy Document SPD-18 provides that SMD missions must have an EPO program that is funded with at least one percent of the total prime mission cost, excluding launch vehicle. A tentative recommendation for this to be implemented across other directorates was discussed. Mr. Kohrs suggested implementing the recommendation by embedding in the EPO office one person from each Mission Directorate with that Mission Directorate's EPO funding. Dr. Huntress explained that the actual percentage has varied from one-half percent to two percent, and that the competitive missions are where this is enforced. Mr. Perkins will use this information in developing the recommendation.

Dr. Squyres thanked Mr. Perkins for his presentation.

Information Technology Infrastructure Committee Report

Dr. Squyres introduced Dr. Larry Smarr, Chair, Information Technology Infrastructure (ITI) Committee. Dr. Smarr described new members on the Committee and acknowledged Ms. Rausch for her efforts in developing and increasing the Committee's membership. He described recent work by the NASA Short-term Prediction Research and Transition (SPoRT) Center at Marshall. It is engaged in transitioning research data to the operational weather community. Web services provided by SPoRT to support disaster applications were described. SPoRT's success is due, in part, to access to advanced information technology. Dr. Smarr discussed "cloud" computing resources that are used to support partnering projects. The SPoRT Visualization, and Colorization Lab was described. The Center for Internal Mobile Applications (CIMA) is a website where NASA employees and contractors can download mobile apps that access NASA systems. The critical factors that make CIMA a success are executive sponsorship, a clearly defined scope, coordination with IT security, a scalable infrastructure, an agile architecture that can support emerging mobile platforms, a marketing and communication strategy, a dedicated team, and a pilot users group. The support provided by the NASA Office of the Chief Information Officer (OCIO) high-performance networking was described. A chart was presented to illustrate NASA's Communications Service Office (CSO) Wide Area Network (WAN) backbone. An experiment on high-speed data backup was described. Dr. Smarr explained that the groundwork is being laid for more use of the commercial cloud, and that NASA represents only a small customer base for the cloud. He referred to a previous NAC recommendation for NASA to pursue IT partnerships with other Federal agencies and presented a chart on partnering opportunities with the Department of Energy (DOE). The 100 Gbps Consortium for Petascale science was described. A slide showing a demonstration 100 Gbps file transfer was discussed. Dr. Smarr acknowledged work being done in this field by Mr. Bill Fink and Mr. Paul Lang, two NASA high performance network innovators, and the High End Computer Networking (HECN) team at the NASA Goddard Space Flight Center (GSFC) Science and Exploration Directorate.

Dr. Smarr presented a proposed finding calling for NASA's CSO to develop the business case for acquiring dedicated fiber-optic pathways. At Dr. Squyres' request, Dr. Smarr agreed to redraft the finding as a recommendation and to present it at the next NAC meeting.

Dr. Smarr presented a proposed finding expressing encouragement over multi-center collaborations. The Council approved the finding as follows:

The Council is encouraged by the multi-center collaborations involved in engineering activities to upgrade Marshall Space Flight Center's Huntsville Operations Support Center (HOSC) and Payload Operations and Integration Center (POIC). Not only with the traditional human spaceflight centers, such as Johnson Space Center and Kennedy Space Center, but also engineering expertise and tools from Goddard Space Flight Center, Ames Research Center, Jet Propulsion Laboratory, etc., are being incorporated into this activity.

Dr. Smarr discussed Internet connectivity aboard the ISS. He described a 3-D high definition television camera made by Panasonic that was used on the ISS and returned to Earth after 19 months in orbit. Radiation had ruined the detectors on other cameras previously brought to the ISS. For unknown reasons, there were no visible pixel defects in the Panasonic camera, even though the camera had not been space qualified. Dr. Smarr described Disruption Tolerant Networking (DTN), which adapts Internet protocols for in-space application. He explained that this is how the Internet will be provided throughout the solar system.

The Expressome was described as the "telescope for life sciences." It is the sum of transcriptome, proteome, metabolome and epigenome. Dr. Smarr asserted that this is the frontier of quantifying living things. The geneLAB Science Campaign Platform was described. It is an open-source science platform for experiments to be conducted on the ISS. Dr. Smarr believes it should be used for experiments on microbes, which are tiny chemical factories that change with radiation and express themselves differently under weightless conditions. He noted that the human body is 90 percent microbial.

Dr. Smarr presented a proposed finding that there are multiple opportunities for the ITI Committee to work with the HEO Committee on IT innovations within the ISS program. Dr. Kennel noted that the Augustine Commission had developed rationales for extending the ISS lifetime, and one was to expand the user group to space-naïve users. He suggested that the high capacity Internet connection makes that possible and, if it is developed, could provide the main scientific reason for continuing the ISS beyond 2020. Dr. Squyres explained that the proposed finding only affects the Council's internal operations and, therefore, need not be submitted to the Agency. Dr. Smarr was encouraged by the Council to proceed with his interest in working with the HEO Committee. It will be adopted as an action item for the Council. Dr. Smarr discussed a draft recommendation in development for NASA to review the existing national data cyber-infrastructure supporting access to data repositories for NASA SMD missions.

Dr. Squyres thanked Dr. Smarr for his presentation.

Commercial Space Committee

Dr. Squyres re-introduced Ms. Patti Grace Smith, who presented a revised recommendation for NASA to evolve its workforce to accommodate the Agency's future direction in overseeing commercial initiatives. The recommendation had been revised to include additional background information about the need for new hires, as requested by Dr. Squyres earlier in the meeting. The Council approved the following recommendation:

As a follow-up to Council Recommendation 2012-02-02 (CSC-01), the Council recommends that NASA revisit its near-term human capital planning to include specific new hires with significant outside business experience to enhance implementation of the Agency's vision of space commercialization.

Dr. Squyres thanked Ms. Smith for her presentation.

Public Input

Dr. Squyres invited comments from the public. There were none.

Council Discussion

Potential dates and locations for future Council meetings were discussed. The Council agreed on the following dates and venues for its meetings in CY 2013, subject to final coordination with the Office of the NASA Administrator:

- March 6-7 at NASA Headquarters in Washington, DC;
- July 30 at NASA Headquarters (annual all-hands meeting) and August 1-2 at Wallops Flight Facility, VA;
- December 11-12 at Kennedy Space Center, FL

Adjournment

The meeting was adjourned for the day at 4:45 p.m.

*Friday, November 30, 2012*Call to Order, Announcements

Ms. Rausch called the meeting to order and welcomed everyone to the third day of the meeting. She stated that the NAC is a Federal advisory committee established under the FACA. The meeting is open to the public. A dial-in capability is available for members of the public to listen to the meeting. WebEx is also available. Meeting minutes will be posted to the NAC web site, www.nasa.gov/offices/nac, soon after the meeting. All presentations will be part of the public record. Time has been set aside at the end of the day for public input.

Remarks by Council Chair

Dr. Squyres welcomed everyone to the meeting.

Technology and Innovation Committee Report

Dr. Squyres introduced Dr. William Ballhaus, Chair, Technology and Innovation Committee. Dr. Ballhaus explained that the scope of the Committee includes all NASA programs that could benefit from technology, research, and innovation. He reviewed the Committee's membership and described the presentations that had been given to the Committee at its last meeting. A chart was presented showing the nine programs in the Space Technology Program (STP). Recently developed space technology hardware was shown on a slide. A chart was presented showing how grants from the Space Technology Research Grant Program (STRGP) have been distributed to universities across the nation. He discussed recent success in NASA's Hypersonic Inflatable Aerodynamic Decelerator (HIAD) project, and noted that the Inflatable Reentry Vehicle Experiment (IRVE-3) had successfully demonstrated key technologies. A slide was presented showing the family of Mars rovers.

Dr. Ballhaus noted that NASA programs are being executed today based on technology investments made in the past. A slide was presented showing FY 2012 accomplishments in the crew mobility systems domain. A new rear-entry spacesuit, the Z-1, has been developed and pressure tested. A prototype Portable Life Support System for the advanced spacesuit was described. The Multi-Mission Radioisotope Thermal Generator used on the MSL was described. A slide showing MSL entry, descent and landing (EDL) technologies was presented. Instrumentation on the MSL heatshield provided data indicating that the heatshield had been over designed. That data will be used to design future systems. It was noted that the Strategic Space Technology Investment Plan (SSTIP), which provides investment guidance for the next four years, is under review at OMB.

Dr. Ballhaus discussed several Committee findings that were not being submitted as proposed Council findings or recommendations. The major missions being flown today are dependent on technology investments made years ago. NASA should maintain a corporate memory on technology infusion into key missions to justify future investments to OMB and Congress. NASA's technology shelf has been depleted over the last decade due to a lack of investment.

NASA has begun to correct this over the last three years through the STP and other programs. The Committee is impressed with the STP's progress and sees that it has gained maturity, momentum, and some budget stability. The STP needs to enhance its engagement with commercial space. Eighty-five percent of milestones on technology demonstrations are being met, which leads the Committee to question whether the right risk posture has been set for advancing technologies. If risk is increased, the stakeholder community must be conditioned to accept failures. When NASA executes key missions, it should be enriching the Nation's technology base. In spite of the challenges, it is advantageous to insert technology measurement into flight missions to sharpen engineering analysis and design tools. The success of the STRGP is encouraging. Mentorship has been a key to that success; however, the lack of hiring slots impedes refreshing the NASA technical workforce. The recent reorganization separating the STP from the Office of Chief Technologist (OCT) makes sense because it separates line and staff responsibilities for technology development.

Dr. Kennel noted that most mission mistakes are made in the conceptualization phase, and he counseled that missions should characterize the level of risk that is intended. He asked what criteria should be used to declare that a mission is too big or important to fail. Dr. Ballhaus responded that if the outcome is unacceptable, then it must be mitigated, regardless of probability. Dr. Kennel concurred. Dr. Squyres counseled that the consequences of a mission failure are not always proportional to the mission cost.

Dr. Squyres thanked Dr. Ballhaus for his presentation.

Council Roundtable Discussion

Dr. Squyres led a roundtable discussion, and solicited final general comments from the Council members.

Mr. Hanisee observed that things are working well at NASA from the audit and finance perspective, and that the Agency has made enormous progress, particularly in getting data to actively manage programs. His primary concern is to make sure there is no backsliding.

Dr. Kennel noted that there had been a problem with the means for the science community to give advice to NASA. The connections had become frayed and the channels unclear. It is his ambition is to get the advisory process "sutured" together. On the NAC side, through the efforts of Dr. Squyres and Dr. Kenneth Ford, former NAC Chair, things are getting back on track. Dr. Squyres agreed that the communications process has improved and counseled that while everyone is bound by the organizational structure, nothing should stand in the way of common sense.

Mr. Perkins expressed a need for the EPO Committee to be constituted with members who are willing to participate and contribute. He wants to help coach staff at NASA Headquarters on achieving results related to the Committee's recommendations. He suggested adopting a higher risk factor on recommendations because a 100 percent acceptance rate indicates they are not providing sufficiently bold recommendations. Dr. Squyres encouraged the Council members to think less about a favorable response from the Council and more as to what would improve the Agency.

Dr. Smarr expressed concern that the Council lacked the expertise in medical and life sciences that will be needed due to the significantly decreased costs for DNA technology. It is now possible to define a living system from a fundamental basis, rather than a medical basis, and this has led to a digital transformation of medicine on the ground. A committee on biological and life sciences may be needed. Mr. Kohrs responded that a life sciences subcommittee of his HEO Committee is in the process of being established by NASA. This had been a prior NAC recommendation that the Agency had approved. Ms. Rausch added the subcommittee had recently been formally named as the "Research Subcommittee" and that the proposed Terms of Reference for this subcommittee were in the final review process at NASA Headquarters prior to signature by NASA Administrator Bolden.

Dr. Squyres stated that the Council's most important function is to be alert to new items that cut across traditional lines and traditional organizational structures within the Agency.

Ms. Blakey noted that there is a need to look at verification and validation as a crosscutting issue, and that her Aeronautic Committee lacks that expertise. She observed that there is a need for clarity on what is expected from the NAC committees, versus the National Research Council and other advisory groups. Dr. Squyres explained it is his

philosophy that the most expertise exists at the NAC committee level, and that the Council should not direct the committees on where emphasis should be placed. It is the committee's responsibility to define its role as it sees fit, and the Council trusts the committee to do that.

Mr. Kohrs noted that the HEO Committee intends to focus on crew certification and the destination for NASA's primary mission. He explained that there is a limit to the availability of funding and that it is important, therefore, to select a path and determine how to get there. He noted that Dr. David Longnecker, a member of the HEO Committee will be chairing the new Research Subcommittee. He reported that Admiral Joseph Dyer, Chair, NASA Aerospace Safety Advisory Panel (ASAP), had attended the last HEO Committee meeting and has invited NAC members to attend future ASAP meetings.

Dr. Squyres explained that the most pressing issue facing the Agency is the future of human spaceflight with a clearly articulated goal and a path to that goal that makes sense within budget reality. The hope is for the Council to help the Agency find the path.

In conclusion, Dr. Squyres thanked everyone from Marshall Space Flight Center for hosting a fantastic meeting, and specifically acknowledged the efforts of Ms. Pat Fuller, Protocol Officer, and her assistant, Ms. Dena Yell. Dr. Squyres also expressed his appreciation to the Council members for their valuable time. Mr. Perkins, on behalf of the Council members, thanked Dr. Squyres for his leadership.

Public Input

Dr. Squyres invited comments from the public. There were none.

Adjournment

The meeting was adjourned at 11:30 a.m.

NASA ADVISORY COUNCIL MEETING**NASA Marshall Space Flight Center
Huntsville, Alabama 35812****PUBLIC MEETING****November 28-30, 2012****Agenda****Wednesday, November 28****Council Public Meeting***MSFC Building 4200, Rooms P-110 (10th floor)*

1:00 – 1:03 pm	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
1:03 – 1:10 pm	Opening Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
1:10 – 1:30 pm	Welcome to NASA Marshall Space Flight Center	Mr. Patrick Scheuermann, Director Marshall Space Flight Center
1:30 – 2:15 am	Remarks by NASA Administrator	Mr. Charles F. Bolden, Jr. NASA Administrator
2:15 – 2:30 pm	Council Discussion	
2:30 – 3:30 pm	NASA Plans for Future Human Spaceflight	Mr. Bill Gerstenmaier Associate Administrator Human Exploration and Operations Mission Directorate, NASA HQ
3:30 – 3:45 pm	Break	
3:45 – 4:45 pm	Human Exploration and Operations Committee Report	Mr. Richard Kohrs, Chair
4:45 – 5:00 pm	Public Input; Council Discussion	
5:00 pm	Adjourn	

Thursday, November 29**Council Public Meeting***MSFC Building 4200, Room P-110 (10th floor)*

9:00 – 9:02 am	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
9:02 – 9:10 am	Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
9:10 – 10:00 am	Aeronautics Committee Report	Ms. Marion Blakey, Chair
10:00 – 10:45 am	Audit, Finance, and Analysis Committee Report	Mr. Robert Hanisee, Chair
10:45 – 11:00 am	Break	
11:00 – 11:45 am	Science Committee Report	Dr. Wesley Huntress, Chair
11:45 – 12:00 noon	Council Discussion	
12:00 – 1:00 pm	<u>Lunch</u>	
1:00 – 1:45 pm	Solar Instrumentation at Marshall Space Flight Center and Sounding Rockets	Dr. Jonathan W. Cirtain, Astrophysicist MSFC
1:45 – 2:30 pm	Commercial Space Committee Report	Ms. Patti Grace Smith, Chair
2:30 – 3:15 pm	Education and Public Outreach Committee Report	Mr. Lars Perkins, Chair
3:15 – 3:30 pm	Break	
3:30 – 4:15 pm	IT Infrastructure Committee Report	Dr. Larry Smarr, Chair
4:15 – 4:30 pm	Public Input; Council Discussion	
4:30 pm	Adjourn	

Friday, November 30**Council Public Meeting***MSFC Building 4200, Room P-110 (10th floor)*

9:00 – 9:02 am	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
9:02 – 9:10 am	Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
9:10 – 10:00 am	Technology and Innovation Committee Report	Dr. William Ballhaus, Chair
	Council Roundtable Discussion	
11:30 am	Adjourn	

NASA ADVISORY COUNCIL MEMBERS

November 2012

Role	Council Members
Chair – NASA Advisory Council	Dr. Steven Squyres , <i>Goldwin Smith Professor of Astronomy, Cornell University</i>
Chair – Aeronautics Committee	The Honorable Marion Blakey , <i>Chief Executive Officer, Aerospace Industries Association</i>
Chair – Audit, Finance, and Analysis Committee	Mr. Robert M. Hanisee , <i>CFA, Managing Director, Trust Company of the West</i>
Chair – Commercial Space Committee	Ms. Patti Grace Smith , <i>Patti Grace Smith Consulting, LLC</i>
Chair – Education and Public Outreach Committee	Mr. Lars Perkins , <i>Entrepreneur</i>
Chair – Human Exploration and Operations Committee	Mr. Richard Kohrs , <i>NASA (Ret.)</i>
Chair – Information Technology Infrastructure Committee	Dr. Larry Smarr , <i>Director, California Institute for Telecommunications and Information Technology</i>
Chair – Science Committee	Dr. Wesley T. Huntress, Jr. , <i>Director Emeritus, Geophysical Laboratory, Carnegie Institute of Washington</i>
Chair – Technology and Innovation Committee	Dr. William F. Ballhaus Jr. , <i>President and Chief Executive Officer (Ret.), The Aerospace Corporation</i>
Ex-Officio Members	Gen. Lester Lyles , <i>USAF (Ret.), Chair, Aeronautics and Space Engineering Board, National Academies</i> Dr. Charles F. Kennel , <i>Chair, Space Studies Board, National Academies</i>

**NASA ADVISORY COUNCIL
Marshall Space Flight Center
Huntsville, AL
November 28-30, 2012**

MEETING ATTENDEES

NASA Advisory Council Members:

Dr. Steven W. Squyres, *Chair*
Dr. William F. Ballhaus Jr.
Ms. Marion C. Blakey
Mr. Robert M. Hanisee
Dr. Wesley T. Huntress, Jr.
Mr. Richard Kohrs
Mr. Lars Perkins
Dr. Larry Smarr

Ms. Patti Grace Smith
Dr. Charles F. Kennel, *Ex-Officio Member*

Ms. P. Diane Rausch, *Executive Director*

Cornell University
The Aerospace Corporation (Ret.)
Aerospace Industries Association
Trust Company of the West
Carnegie Institute of Washington
NASA (Ret.)
Entrepreneur
California Institute for Telecommunications
and Information Technology
Patti Grace Smith Consulting, LLC
Space Studies Board, National Academy of
Sciences
NASA Headquarters

NASA Attendees:

Carballosa, Digna
Clinton, Corky
Doering, Steve
Dumenlin, John
Ehmen, Jeff
Fischer, Richard
Fry, Emma
Fuller, Pat
Gallagher, Dennis
Gelms, Gregg
Gerstenmaier, Bill
Kasper-Wolfe, Janet
King, Marla
Lambing, Steve
Love, Willie T.
Mastalski, Tony
Palacios, Tina
Reuter, Jim
Ridinger, Shannon
Robinson, Shawanda
Rowan, Tammy B.
Spann, Jim
Stanfield, Jennifer

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Stephenson, Johnny F.
Storey, Angela
Stroud, Sherri
Walker, Erin
Watkins, Bobby
Williams, Diedra
Worley, Lanier
Zigler, Troy

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Other Attendees:

Abel, Terry
Frankel, David
Iris, Jeff
Koshut, Tom
Richardson, Larry
Roop, Lee
Russell, Gordon
Segina, Jim

Lockheed Martin
PB Frankel LLC/Zantech
ISI
University of Alabama/Huntsville
United Launch Alliance
Huntsville Times
ATK
WAFF/NBC Channel 48

**NASA ADVISORY COUNCIL
Marshall Space Flight Center
Huntsville, AL
November 28-30, 2012**

LIST OF PRESENTATION MATERIAL

- 1) NASA Plans for Future Human Spaceflight [Gerstenmaier]
- 2) Human Exploration and Operations Committee Report [Kohrs]
- 3) Aeronautics Committee Report [Blakey]
- 4) Audit, Finance, and Analysis Committee Report [Hanisee]
- 5) Science Committee Report [Huntress]
- 6) Commercial Space Committee Report [Smith]
- 7) Education and Public Outreach Committee Report [Perkins]
- 8) Information Technology Infrastructure Committee Report [Smarr]
- 9) Technology and Innovation Committee Report [Ballhaus]